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10 December 1976

U S S R

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E U R O P E

USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS  
MATERIALS SCIENCE AND METALLURGY  
No. 41



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No. 41

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CONTENTS	PAGE
Coatings .....	1
Composite Materials .....	2
Conferences .....	5
Corrosion .....	6
Instrumentation and Equipment .....	14
Mechanical Properties .....	15
Powder Metallurgy .....	17
Single Crystals .....	21
Steels .....	22
Thermomechanical Treatment .....	26
Thin Films .....	27
Titanium .....	29
Welding .....	35
Miscellaneous .....	39

Coatings

USSR

UDC 539.23

OSADIN, B. A., and SHAPOVALOV, G. I., Moscow

APPLICATION OF THIN COATINGS WITH THE USE OF IMPULSE PLASMA GENERATORS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Sep-Oct 76  
pp 42-52 manuscript received 13 Feb 76

[Abstract] The investigation compared stationary and impulse methods for applying thin coatings, and results indicated that impulse methods had the advantages of higher efficiency and more rapid deposition. Specific features of impulse plasma currents were measured for an aluminum electrode. The dynamics of the process include an unstationary stage that has been called a "fountain pinch." When the current is reduced through heat inertia the relationship of magnetic pressure to gas kinetic energy decreases sharply. Erosion characteristics of generators, macrodefects, and adhesion further confirm the effectiveness of the impulse plasma method. Defects were primarily in the form of droplets of coating. The excellent adhesion obtained, particularly with refractory metal coatings is apparently related to the high energy of the atoms being deposited, and the force density. It was also possible to deposit very thin coatings with an accuracy of at least 5-10 percent. Figures 5; references 20: 15 Russian and 5 English.

1/1

Composite Materials

USSR

UDC 541.1

VARENKOV, A. N., GOLOSHCHAPOV, F. A. and MOZHUKHIN, YE. I., Moscow Institute of Steel and Alloys

INFLUENCE OF HEATING TEMPERATURE ON THE STRUCTURE AND FINE CONSTRUCTION OF A POLYACRYLNITRILE (PAN) FILAMENT

Moscow IZVESTIYA VUZ, CHERNAYA METALLURGIYA in Russian No 9, 1976  
pp 9-13 manuscript received 23 Mar 76

[Abstract] The authors investigated the structure and strength properties of carbon-graphite filaments produced at 1000, 2000, 2750 and 3000°C from polyacrylnitrile. Using the method of x-ray structural analysis they determined the dependences of the interplanar distances, dimensions of the quasicrystallites and their orientations on temperature of producing the filament. Increasing the temperature of shaping the filament leads to a reduction in the size of the interplanar distance from 6.831 to 6.798 Å, to a growth in the quasicrystallite from 14 to 99 Å, and to a decrease in the degree of their disorientation with respect to the axis of the filament. Repeated annealing influences the structure and

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USSR

VARENKOV, A. N., GOLOSHCHAPOV, F. A. and MOZHUKHIN, YE. I., IZVESTIYA VUZ, CHERNAYA METALLURGIYA, No 9, 1976 pp 9-13

properties of the filaments if the temperature of repeated annealing exceeds the temperature of producing the carbon-graphite filament. Neutron irradiation greater than 0.5 MeV reduces the strength of the carbon-graphite filaments as a function of the radiation dose. Figures 2; tables 2; references 7: 3 Russian, 4 Western.

2/2

USSR

UDC 546.821'27+546.621:666.3

KRYLOV, YU. I.

COMPOSITE MATERIAL BASED ON  $TiB_2$ - $Al_2O_3$

Moscow IZVESTIYA AKADEMII NAUK SSR, NEORGANICHESKIY MATERIALLY in Russian  
No 9, 1976 pp 1684-1685 manuscript received 22 Nov 74

[Abstract] A report is presented on work performed by methods of thermogravimetric, chemical, X-ray and microscopic analyses of pressed powdered mixtures after heat treatment. Powders of titanium diboride with Ti-68.9, B-30.6 and C-0.35 wt.% and synthetic corundum were used. The experiments showed that with decreasing  $Al_2O_3$  grain size, that is, with increasing specific surface, a regular increase in the density of the hot pressed material is observed. The granularity of the powdered  $TiB_2$  introduced is determined by the conditions of formation of the reaction products, which facilitate sintering, and is less than 70  $\mu m$  for the material with maximum density.

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USSR

UDC 621.763(088.8)

SHORSHOROV, M. KH., TIKHONOV, A. S., BULAT, S. I., PROKHOROVA, I. I., FRANTOV, I. I., NADIRASHVILI, N. I. and SHAMTSYAN, V. P., Institute of Metallurgy imeni A. A. Baykov

A METHOD OF MAKING COMPOSITE MATERIALS

USSR AUTHOR'S CERTIFICATE No 432973, Division B, filed 14 Jul 72, published 18 Sep 75

[From REFERATIVNYY ZHURNAL, METALLURGIYA, No 8, 1976 Abstract No 8G536P]

[Text] A method is proposed for producing composite materials that involves making a matrix in the form of a metal band, reinforcing the matrix with fiber, simultaneous deformation of matrix and fiber, and annealing. The physical and mechanical properties of the material are improved by carrying out combined deformation of matrix and fiber at temperatures where the matrix is exceptionally ductile (65-90% of the melting point) at a strain rate of  $0.01-10 \text{ sec}^{-1}$  to a total deformation of 80-95%.

1/1

3

USSR

UDC 669.71

TIKHONOV, A. S., GERASIMOV, A. P., SHORSHOROV, M. KH., MANUYLOV, V. F., and PROKHOROVA, I. I., Moscow

#### COMPOSITES FOR SELF-ERECTING STRUCTURES

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Sep-Oct 76  
pp 109-112 manuscript received 26 Mar 76

[Abstract] Methods are examined for producing objects of composite materials containing an alloy with martensite memory to aid in shape retention. Nitinol ingots were melted in a vacuum furnace, then cut into bands and heated again to 1050°C. Under high pressure they were compressed to 1 mm, and even thinner specimens were obtained by cold rolling with heating to 900° and tempering at that temperature. Then two variants were attempted for obtaining self-erecting structural materials--pack rolling and plasma spraying. Details of these methods are described, and calculations of bending and other features are presented, to show the advantages of the metal's memory. The formation of the required shape is assured by reversion tension in the material, in which when heated above the temperature of reverse martensite transformation, the form of the object is transferred to the work element before the 1/2

USSR

TIKHONOV, A. S., GERASIMOV, A. P., SHORSHOROV, M. KH., MANUYLOV, V. F., and PROKHOROVA, I. I., FIZIKA I KHIMIYA OBRABOTKI MATERIALOV No 5, Sep-Oct 76  
pp 109-112

component is obtained through certain pressure processing methods. Stress is placed on the necessity of deformation of the work element in the martensite area in conditions of hyperplasticity. This enables preservation of order in the martensite structure and generation of the ultimate reversion tension. Figure 1; references 6: 5 Russian and 1 English.

2/2

Conferences

USSR

UDC 621.791:061.3

DZHEVAGA, I. I.

MEETING ON MEANS FOR INCREASING THE TECHNICAL AND ECONOMIC INDICATORS OF WELDING PRODUCTION

Kiev AUTOMATICHESKAYA SVARKA in Russian No 9, 1976 p 78

[Abstract] A meeting was held in Nikolayev 7-8 June 1976, dedicated to problems of further increasing the technical and economic indicators and quality of welding at shipbuilding and construction enterprises during the tenth five-year plan. 130 representatives of organizations and plants in Moscow, Leningrad, Kiev, Kherson, Odessa and other cities took part. Subjects discussed included the possibility of further increasing the technical and economic indicators and quality of welding by efficient planning and manufacture of welding structures; the means for creation of new, economical construction structures by enterprises in heavy industry; the condition of the production of welding at construction enterprises in Nikolayev oblast; new welding equipment for arc welding; new types of electrodes; the achievements of welding in the shipbuilding industry; the need for construction of a liquid argon plant in the

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USSR

DZHEVAGA, I. I., AVTOMATICHESKAYA SVARKA No. 9, 1976 p. 78

Nikolayev area; the status of and prospects for electric welding throughout the USSR; the planning, manufacture and use of robots in welding; and some problems in the area of production of welded structures of aluminum-magnesium alloys and cast iron.

2/2

Corrosion

USSR

UDC 620.197.3

GLEYZER, M. M., TSEYTLIN, KH. L., SOROKIN, YU. I., ISAYENKO, G. I.,  
BABITSKAYA, S. M., Scientific Research Institute of Organic Intermediates  
and Dyes

INFLUENCE OF CERTAIN ORGANIC COMPOUNDS ON THE CORROSION OF TITANIUM AND  
TYPE 12Kh18N10T STEEL IN DILUTE SULPHURIC ACID

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 629-633  
manuscript received 22 Mar 75

[Abstract] The influence of organic compounds in quantities of 3 mmol/l and under particular conditions 100 mmol/l on the corrosion of VT1-0 titanium and stainless steel was studied at 60°C in a 10% solution of sulphuric acid, including with the addition of 1.2% chlorine ions. As to their influence on the corrosion of metals in dilute solutions of nonoxidizing acids, organic additives can be divided into two groups: those which have oxidizing properties (aromatic nitrocompounds, nitroso-compounds, certain quinones) and those which have reducing properties (aldehydes, certain carboxylic acids) and antioxidants (certain amines, etc.). The presence of substances in the first group stimulates cathodic processes, causing positive displacement of the stationary

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USSR

GLEYZER, M. M., TSEYTLIN, KH. L., SOROKIN, YU. I., ISAYENKO, G. I.,  
BABITSKAYA, S. M., ZASHCHITA METALLOV Vol. 12 No. 5, 1976 pp 629-633

potentials right up to the area of the passive state. They are effective corrosion inhibitors. Substances in the second group are adsorbed onto the surface of the metal, changing the kinetics of the electrode processes or decreasing the concentration of oxygen and other oxidizers in the corrosive medium (antioxidants). They have no significant influence on the corrosion of the metals tested in 10%  $H_2SO_4$ .

2/2

USSR

UDC 620.197.6

ANDREYEV, YU. YA., BRODSKAYA, A. G., ZHUK, N. P., PLAVICH, L. A.,  
Moscow Institute of Steel and Alloys

PROTECTION OF STEELS FROM HYDROGEN EMBRITTLEMENT BY GALVANIC TITANIUM  
COATINGS

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 617-619  
manuscript received 28 Mar 75

[Abstract] A study is made of the effectiveness of protection of steels types D, 36G2S and 38KhNM against hydrogen embrittlement by galvanic titanium coatings produced from a melted chloride electrolyte. It was found that titanium coating of the steels greatly decreased their tendency toward hydrogen embrittlement and can be used as a means of effective protection of high strength steels from hydrogen embrittlement.

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USSR

UDC 620.193.01

KONSTANTINOVA, YE. V., MURAV'YEV, L. L., Sverdlovsk Scientific Research Institute for Chemical Machine Building

THE TIME FACTOR IN CORROSION INVESTIGATIONS

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 599-620  
manuscript received 13 Mar 75

[Abstract] A method is suggested for determination of the duration of corrosion testing, determination of the rate of corrosion in the stable process and the form of the empirical formula for processing of experimental data on the kinetics of corrosion. Information on the process of corrosion which is important for practical purposes can be produced by processing experimental data relative to the change in the degree of corrosion with time. The quantities included in the calculation formulas can be determined from the condition of the minimum of the sum of squares of deviations of calculated quantities of corrosion from experimental quantities. Studies performed of the equation presented for this purpose show that it may have an ambiguous solution in some cases.

1/1

USSR

UDC 620.195.5

VOYTOVICH, R. F., GOLOVKO, E. I., D'YAKONOVA, L. V., Institute of Problems of Material Science, Academy of Sciences UkrSSR

OXIDATION OF TITANIUM-ZIRCONIUM ALLOYS

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 590-594  
manuscript received 2 Jul 74

[Abstract] This work presents a study of the oxidation of binary Ti-Zr alloys in air at temperatures from 600 to 1200°C. The alloys were made in an arc furnace of iodide titanium and zirconium. A figure shows the influence of composition on relative rate of oxidation of the alloys over 3 hours at 600, 800, 1000 and 1200°C. The parabolic oxidation rule is observed only for alloys containing up to 10% Zr at 1000 and 1200°C. With 30% Zr, the rule is paralinear. In all other cases it is complex.

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USSR

UDC 620.193.16

KOCHEROV, V. I., KARASYUK, YU. A., GALAKTIONOVA, N. L., Ural Polytechnical Institute imeni S. M. Kirov

ELECTROCHEMICAL BEHAVIOR OF TYPE 1Kh18N10T STAINLESS STEEL WITH CAVITATION

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 582-585  
manuscript received 23 Dec 74

[Abstract] A study is made of the change in polarization curves under the influence of cavitation, and the fraction of electrochemical damage to a specimen in the total mass loss is estimated. The method used is potentiodynamic measurement of polarization curves with ultrasonic vibration of the working electrode, serving simultaneously as a wave guide, allowing regulation of the intensity of cavitation over a broad range. The steel was studied in the annealed state in 1 n H<sub>2</sub>O<sub>4</sub> at 25±1°C. The observations showed that the corrosion potential upon cavitation becomes 50-90 mv more positive.

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USSR

UDC 620.193.2

KALININ, V. D., BUDOV, G. M., SINYAVSKIY, V. S.

CORROSION OF HIGHLY ALLOYED ALUMINUM UNDER ATMOSPHERIC CONDITIONS

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 571-575  
manuscript received 25 Oct 74

[Abstract] A study is made of profiles 4.0 mm thick of the alloys D16g/p (no heat treatment), D16T, V95T1, AK6T1, V92T, T1, as well as clad sheets of alloys D16T, V95T1 and a sheet of D16 without cladding (sheet thickness 1.0-1.4 mm). A table presents the corrosion characteristics of the alloys after five years testing under various weather conditions. As the content of chlorides increased, the sensitivity of the alloys to layer separation corrosion increased greatly. For alloys sensitive to layer separation corrosion, an industrial atmosphere was much more corrosive than a southern seaside atmosphere.

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USSR

UDC 620.198

ROZENFEL'D, I. L., OL'KHOVNIKOV, YU. P., LOMAKINA, S. V., Institute of Physical Chemistry, Acad. Sci. USSR

METHOD OF MEASURING THE IMPEDANCE OF ELECTRODES AT HIGH TEMPERATURES AND PRESSURES

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 567-570 manuscript received 21 Feb 75

[Abstract] To permit studies of the electrode-electrolyte boundary directly in the autoclave, a method of impedance measurements and a design of an autoclave with a working volume of 100 cm<sup>3</sup> were developed. The body and cover of the autoclave are made of stainless steel; the seal is a "cylinder in cone" type without any liner. The electrode studied is located in the central axis of the autoclave near the junction of a thermocouple, assuring even polarization of the specimen and good accuracy of measurement of temperature. The electrodes studied, in the form of spirals of wire, are insulated from the body of the autoclave. The inner surface of the autoclave is used as the supplementary electrode. All measurements are performed in a 0.01 n solution of ammonium nitrate. Observation of these conditions assures correct results, allowing observation of the change in dielectric properties of films formed on the surface of aluminum electrodes.

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USSR

UDC 620.193.4

FAYNGOL'D, L. L., TSEYTLIN, Kh. L., Scientific Research Institute for  
Organic Intermediates and Dyes

INTERACTION OF TITANIUM AND ITS ALLOYS WITH BROMINE AND SOLUTIONS OF  
BROMINE IN NITROBENZENE

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 565-567  
manuscript received 27 Mar 75

[Abstract] Alloy VT1-1 ignites in liquid bromine 10 minutes after immersion. Titanium and its alloys VT1-1, VT1-0, OT4-0, VT5-1, VT14, AT3, 4200 and 4201 were studied to determine the induction period before ignition and corrosion rate in bromine and solutions of bromine in nitrobenzene. All of the titanium alloys studied corrode at approximately the same rate with a constant concentration of bromine in nitrobenzene: at room temperature, 6 hr experimental duration and bromine concentration 10 and 25 ml/100 ml  $C_6H_5NO_2$ , the corrosion rates were 35 and 65  $g/m^2 \cdot hr$  respectively. After the experiments, the specimens were covered by a loose layer of corrosion products, easily washed off by acetone. Shaking of test tubes with the specimens increased the rate of dissolution of the

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USSR

FAYNGOL'D, L. L., TSEYTLIN, Kh. L., ZASHCHITA METALLOV Vol. 12 No. 5,  
1976 pp 565-567

metal by a factor of almost 2, as the protective layer on the surface was shaken off and the bromine gained access to the surface of the metal.

2/2

USSR

UDC 620.196

VEDENEYEVA, M. A., CHESKIS, Kh. I., MAISURADZE, T. V., All-Union Scientific Research and Planning-Design Institute for Petroleum Machine Building

INTERCRYSTALLINE CORROSION TENDENCY OF KhN32T (Kh20N32T) ALLOY

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 554-556 manuscript received 6 Jan 75

[Abstract] KhN32T low carbon austenitic steel, previously not produced in the USSR, has satisfactory heat resistance, good technological properties, high temperature strength and structural stability. It is designed for use in petrochemical and chemical production processes at temperatures up to 900°C. Its chemical composition (%) according to All-Union State Standard GOST 5632-72 is: C<0.05; Mn<0.7; Si<0.7; Cr<19-22; Ni 32-34; Ti 0.25-0.60; Al<0.5; S<0.02; P<0.03. This work studies the resistance of the alloy to intercrystalline corrosion as a function of austenitization, heating temperature and time and Ti/C ratio. Due to the high content of nickel in KhN32T, diffusion processes leading to the formation of titanium carbides are inhibited and after the annealing mode in current use the carbon is present in the form of chromium carbides. In the presence of media tending to lead to intercrystalline cracking, alloy KhN32T should not be used at over 500-600°C.

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USSR

UDC 620.193.41

TOMASHOV, N. D., KAZARIN, V. I., MIKHEYEV, V. S., GONCHARENKO, B. A., Institute of Physical Chemistry, Acad. Sci. USSR

INFLUENCE OF RUTHENIUM ON ELECTROCHEMICAL AND CORROSION BEHAVIOR OF TITANIUM AND ALLOYS IN THE TITANIUM-NICKEL SYSTEM IN ACID FLUORIDE SOLUTIONS

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 537-540 manuscript received 30 Jul 75

[Abstract] A study is made of the corrosion and anodic behavior of Ti-Ni solutions (0.5-8%), modified with slight additions of ruthenium (0.2%) in acidified (to pH 0) solutions of 2n NaCl at 100°C. It is established that the corrosion resistance is higher and the effectiveness of Ti-Ni-Ru alloys significantly greater as concerns the anodic process of separation of chlorine in comparison to Ti-Ni alloys and Ti-0.2% Ru alloys.

USSR

UDC 620.193.4

POZDEYEVA, A. A., MIKHAYLOVA, G. G., State Institute for Applied Chemistry

CORROSION OF CERTAIN STEELS AND TITANIUM UNDER CONDITIONS OF CATALYTIC SYNTHESIS OF AROMATIC AMINES

Moscow ZASHCHITA METALLOV in Russian Vol 12, No 5, 1976 pp 541-544  
manuscript received 4 Feb 74

[Abstract] Data are presented on the corrosion resistance of carbon and stainless steels, as well as titanium, under the conditions used for liquid-phase catalytic synthesis of aromatic amines under pressure. The influence of small chloride impurities on corrosion cracking of chrome-nickel steels is demonstrated. Recommendations are given for the selection of structural materials for such processes. The most reliable materials under these conditions are steels alloyed with molybdenum. Steels of this type have lower sensitivity to intercrystalline corrosion in chlorine-containing media and increased time before the appearance of cracking than ordinary stainless steel. Titanium is highly useful for such syntheses, except where there is a danger of hydrogen embrittlement.

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USSR

UDC 620.193;664.14

IDEV'CHIK, B. M., ZIBOROV, I. YE., Nevskiy Machine Building Plant imeni V. I. Lenin, Leningrad

CORROSION CRACKING OF HIGH STRENGTH STEEL EI723I AND AUSTENITIC STEEL EP33

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 12, No 4, Jul-Aug 76 pp 106-107 manuscript received 25 Nov 74

[Abstract] Steels types EI723I and EP33 were tested for corrosion cracking before use as materials to be exposed to coke gas and other gases containing H<sub>2</sub>S. The chemical compositions of the steels are: EI723I: C, 0.03; Si, 0.40; Mn, 0.50; P, 0.005; S, 0.005; Cr, 11.70; Ni, 7.5; Mo, 3.7; W, 0.49; Co, 0.4; Ti, 0.23; EP33: C, 0.09; Si, 0.40; Mn, 0.54; P, 0.016; S, 0.007; Cr, 10.97; Ni, 22.2; Al, 0.96; Mo, 1.30; Cu, 2.13; Ti, 2.80. EP33 steel is shown to have no tendency toward corrosion cracking, which was confirmed by subsequent studies of the mechanical properties of the specimens. No reduction in ductility was observed.

1/1

12

USSR

UDC 620.198

SHEVELYA, V. V., VENEDIKTOV, V. A., OLEYNIKOV, S. L., Kiev Institute of Civil Aviation Engineers; Kiev Polytechnical Institute

THE ROLE OF STRUCTURAL CHANGES AND ADSORPTION PHENOMENA IN THE CORROSION FATIGUE OF METALS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 12, No 4, Jul-Aug 76 pp 55-60 manuscript received 1 Feb 75

[Abstract] An attempt is made to establish the relationship between structural changes inherent in typical fatigue and the kinetics of corrosion processes during corrosion fatigue. The change in electrode potential, corrosion current and capacitance of the binary electric layer are studied upon loading of Armco iron and type 45 steel with low and high deformation amplitudes in a 3% NaCl solution. There are two curves, each with its own maximum, corresponding to the potential of the uncharged surface. In the case of anodic polarization there is no adsorption and the maximum strength of the oxidized metal is observed. In the case of cathodic polarization at the cathodic potential there is also no adsorption and the maximum strength is observed, but of the

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USSR

SHEVELYA, V. V., VENEDIKTOV, V. A., OLEYNIKOV, S. L., FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV Vol. 12 No. 4, Jul-Aug 76 pp 55-60

nonoxidized metal. In the general case, corrosion fatigue of metals in a corrosive medium manifests adsorption surface-active properties.

2/2

Instrumentation and Equipment

USSR

UDC 621.378.325

KOSYREV, F. K., KOSYREVA, N. P., LUNEV, YE. I.

THE LT-1 EXPERIMENTAL LASER INSTALLATION

Kiev AVTOMATICHESKAYA SVARKA in Russian No 9, 1976 pp 72-73

[Abstract] The installation is a high-speed electric discharge CO<sub>2</sub> laser with closed gas dynamic cycle and transverse pumping. The direction of gas flow, optical axis of resonator and electric field vector form three mutually perpendicular axes. A three-pass Z-shaped unstable resonator with a transparency of 35-40% is used to convert the energy of excitation of the molecules to light energy. Long-term continuous generation of radiation at 10.6  $\mu\text{m}$  with powers of up to 5.2 kw has been achieved. The installation is used for welding and cutting of various materials up to 10 mm thick.

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## Mechanical Properties

USSR

UDC 669.14.018.44:621.78:620.17

SEmenov, V. N., Sagalovich, V. V.

### INFLUENCE OF HEAT TREATMENT ON MECHANICAL PROPERTIES OF KhN67MVTYu STEEL

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No. 9, 1976 pp 54-56

[Abstract] A study is made of the structural transformations occurring in dispersion-hardened heat resistant type KhN67MVTYu steel based on Ni-Cr (0.05% C; 18.9% Cr; 1.1% Fe; 1.4% Al; 4.8% Mo; 0.2% Si; 4.5% W; 2.3% Ti; 0.004% P and S; Ni -- remainder) as it is heated for 25 minutes and held three minutes at 920°C. The influence of structural conversions on the mechanical properties of these alloys was studied under the same heating conditions. It is found that after hardening from 1100°C in air, the steel undergoes significant structural changes at 720-875°C, indicated by the low level of deformation capability. Therefore, this temperature interval is probably the most dangerous from the standpoint of appearance of cracks in the metal during manufacture of structures. After multistage heat treatment, the alloy has good ductility, remaining practically the same up to 810°C and gradually increasing with increasing temperature.

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USSR

UDC 620.186.4:539.52

KUKSA, L. V., Volgograd Institute of Civil Engineers

### MICROHETEROGENEITY OF DEFORMATION AND DUCTILITY OF STEEL

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No. 9, 1976 pp 66-67

[Abstract] A study is made of the mechanical properties and regularities of microheterogeneous plastic deformation of steels types 45 and U7 as a function of structure. The plasticity of the steels is found to be in inverse dependence on microheterogeneity of deformation. A change in the content of carbon from 0.42 to 0.66% has little influence on the microplastic deformation of steel with sorbite structure after hardening and tempering. Ductility in this case also does not change. In annealed steels, the increase in carbon content increases the degree of heterogeneity of microdeformation, helping to reduce ductility.

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15

USSR

UDC 621.791.011

KASATKIN, B. S., MUSIYACHENKO, V. F., VASIL'YEV, V. G., YAMSKOY, M. V.,  
YE. O. Paton Electric Welding Institute, Acad. Sci. UkrSSR

STRUCTURE AND MECHANICAL PROPERTIES OF METAL IN THE ZONE OF THERMAL  
INFLUENCE IN 03G4AF STEEL

Kiev AVTOMATICHESKAYA SVARKA in Russian No 9, 1976 pp 38-40 manuscript  
received 3 Oct 75

[Abstract] The Central Scientific Research Institute for Ferrous Metallurgy has developed a high strength manganese steel type 03G4AF, with the following composition (%):C 0.04, Si 0.32, Mn 3.9, V 0.14, Al 0.037, N<sub>2</sub> 0.022, S 0.013, P 0.010. The required mechanical properties of the steel are achieved after normalization at 900°C and high tempering at 650°C and are:  $\sigma_{0.2}=66\text{kg/mm}^2$ ,  $\sigma_b=81\text{kg/mm}^2$ ,  $\delta=20\%$ ,  $\psi=63\%$ ,  $a_n^{+20^\circ\text{C}}=13.5\text{ kg}\cdot\text{m}/\text{cm}^2$ ,  $a_n^{-50^\circ\text{C}}=4\text{ kg}\cdot\text{m}/\text{cm}^2$ . The hardness of the metal is HV 254. In welding the new steel it is recommended that the cooling rate be in the interval between 10 and 5.5 C/s, providing optimal mechanical properties of the zone of thermal influence without the formation of cold cracks. The new high strength manganese steel is similar in its sensitivity to thermal cycling in welding to the well-known steel 14Kh26MR.

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## Powder Metallurgy

USSR

UDC 621.912-492.2

SAMSONOV, G. V., ADAMOVSKIY, A. A., Institute of Problems of Material Sciences, Acad. Sci. UkrSSR

### ABRASIVE PROPERTIES OF $\beta$ -B AND TRANSITION METAL BORIDES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 76 pp 72-75  
manuscript received 12 Nov 75

[Abstract] Abrasive disks on bakelite binders containing 62.5 vol.% of grains were manufactured by the same technology used for production of diamond tools. Grinding powders of 200/160  $\mu\text{m}$  were used. Alloy VT1 was ground on a grinding machine with 5% emulsol fluid. The results of measurement of the temperature and residual stresses were processed mathematically. It was shown that the transition metal borides have high wear resistance with titanium. Transition metal borides and  $\beta$ -B are superior in abrasive properties to corundum and carborundum abrasive materials, but inferior to synthetic diamond. Abrasive disks of tungsten boride produce lower temperatures in the process of grinding and stresses in VT1 specimens than disks based on green silicon carbide and aluminum oxide.

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USSR

UDC 621.462

ORDAN'YAN, S. S., UNROD, V. I., POLISHCHUK, V. S., STORONKINA, N. M., Leningrad Technological Institute

### INTERACTION IN THE SYSTEM TaC-TaB<sub>2</sub>

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 76 pp 40-43  
manuscript received 28 Oct 75

[Abstract] The purpose of this work was to study the interaction of tantalum carbide with tantalum diboride over a broad range of temperatures and concentrations. It is shown that the mutual solubility of the components is practically zero up to 2100°C; at 2400°C, up to 3 wt.% is dissolved in TaC; only at 2730°C is about 7 wt.% TaB<sub>2</sub> dissolved in TaC. The state diagram of the system TaC-TaB<sub>2</sub>, constructed on the basis of X-ray structural, metallographic and chemical analyses, measurement of the temperature of beginning of melting of the alloys and microhardness of their structural components, is eutectic in nature with  $T_{\text{eut}} = 2730\text{C}$  ( $\pm 40$ ) and composition 34 wt.% TaC plus 66 wt.% TaB<sub>2</sub>.

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USSR

UDC 621.318:621.762

TUROV, V. D., STARKOV, A. V., Istra

SINGLE CRYSTAL MAGNETS OF ALLOYS BASED ON THE SYSTEM Fe-Ni-Al-Co  
PRODUCED BY SINTERING

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 76 pp 36-39  
manuscript received 12 Feb 75

[Abstract] Considering the insufficiency of the available information, the importance of studies of single crystal sintered magnets and the total lack of any domestic work on this problem, the possibility was studied of producing single crystals of the alloy MMK-8 by sintering. Sintering was performed in a vacuum and in an inert medium at 1290-1410°C for 0.3-10 hr. After cooling with the furnace, macroscopic and microscopic testing of the specimens was performed and the density and orientation of single crystals were determined relative to the longitudinal axis of the cylindrical specimens 8 mm in diameter and 25 mm long. The analyses showed that reliable production of single crystalline specimens occurs only with dispersions of the master CoAl alloy of 50-63 µm in the 1335-1390°C interval. In all cases, oriented growth of

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USSR

TUROV, V. D., STARKOV, A. V., POROSHKOVAYA METALLURGIYA No. 9, Sep 76  
pp 36-39

individual grains begins after a certain incubation period, 20 minutes for one of the alloys tested. Formation of single crystals is observed in no less than 80% of the magnets, but only 10% show a deviation of the direction [100] from the longitudinal axis of the specimen of less than 20°. The chemical composition of the alloy studied is 24% Co, 14% Ni, 8% Al, 3% Cu, remainder iron.

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USSR

UDC 621.762

KIPARISOV, S. S., MEYERSON, G. A., PANOV, V. S., TRET'YAKOV, V. I.,  
SMIRNOVA, M. M., Moscow Institute of Steel and Alloys

STUDY OF THE INFLUENCE OF REFRACTORY CARBIDES ON THE PROPERTIES OF  
SINTERED HIGH-SPEED STEEL

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 76 pp 32-35  
manuscript received 15 Aug 75

[Abstract] A study is made of the influence of slight (3-10 vol.%) additions of niobium carbide or titanium carbide on the process of grinding of chips and granules of atomized R18 high-speed steel powder and on the conditions of pressing and sintering of the powders. The structure and properties of the sintered blanks produced are studied. The addition of titanium or niobium carbides intensifies the process of grinding, changing the percent content of fractions in the powder, reducing the mean diameter of particles of the carbide phase. The structure of the sintered specimens produced consisted of austenite, partially martensite and carbides. The structure had a finer grain and more even distribution of carbide grains than cast and heat-treated

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USSR

KIPARISOV, S. S., MEYERSON, G. A., PANOV, V. S., TRET'YAKOV, V. I.,  
SMIRNOVA, M. M., POROSHKOVAYA METALLURGIYA No. 9, Sep 76 pp 32-35

specimens. Preliminary testing showed an increase in cutting properties by a factor of 2 to 3 in comparison with standard alloys of the same composition.

2/2

USSR

UDC 621.762.4:669.018.25

SEREDA, N. N., GAVRILENKO, A. P., Institute of Problems of Material Sciences, Acad. Sci. UkrSSR

PRESSING OF HARD ALLOY MIXTURES BASED ON TITANIUM CARBIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 76 pp 11-13  
manuscript received 27 Jan 76

[Abstract] A study was made of the dependence of density on pressing pressure of powders of tungsten-free hard alloys TiC-24Ni-6Cr and TiC-17.2Ni-15.3Mo (wt.%). The mixtures were prepared using powders of technical purity. The mixtures were homogenized and crushed in a ball mill lined with hard alloy and using hard alloy balls in alcohol for 50 hours. After crushing, a plasticizer was introduced -- a 3% solution of synthetic rubber in gasoline at 250 cm<sup>3</sup> solution per kg of mixture. The mixture was then dried and screened through a 40 mesh screen. Pressing was performed in envelopes of vacuum rubber in a 50 ton press. None of the specimens produced by isostatic pressing in an elastic envelope had pressing defects normally produced by pressing in metallic press molds. The specimens could be easily worked on metal

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USSR

SEREDA, N. N., GAVRILENKO, A. P., POROSHKOVAYA METALLURGIYA No. 9, Sep 76 pp 11-13

cutting machine tools without cracking or breaking, allowing them to be worked to complex shapes.

2/2

## Single Crystals

USSR

UDC 620.186.4:669.14.018.583

KURDYUMOV, V. G., YERMOLAYEV, G. N., KONYAYEV, YU. S., Institute of High Pressure Physics, Acad. Sci. USSR

PECULIARITIES OF THE GEOMETRY OF SLIPPING IN SINGLE CRYSTALS OF SILICON IRON

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 2, Aug 76 pp 441-444 manuscript received 21 Jan 76

[Abstract] Studies of the peculiarities of plastic deformation of single crystals of Fe-3% Si oriented for twinning shear in the direction of the system [111] (112), with the maximum orientation factor ( $\cos\phi\cos\lambda=0.5$ ) have revealed disappearance of slipping in this system with reduction of temperature. This work discusses possible causes of this phenomenon. The disappearance of the most highly stressed system [111] (112), accompanied by replacement with a secondary system with shear direction [111] is a result of the higher mobility of dislocations in the latter system, which is apparently a result of the primary movement of dislocations along the (101) plane, requiring a lower stress level at these temperatures.

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USSR

UDC 548.736.002

PETROV, D. A., TUMANOV, A. T.

A NEW METHOD OF PRODUCING SINGLE CRYSTAL PRODUCTS

Moscow VESTNIK AKADEMII NAUK SSR in Russian No 9, 1976 pp 120-123

[Abstract] The new process works as follows: melted metal is poured into a ceramic mold, heated in a furnace to a temperature higher than the beginning of crystallization of the alloy. After a slight delay to establish thermal equilibrium in the system, a cooling device is moved toward the bottom of the mold at a predetermined rate. As it approaches the bottom of the mold, seed formation occurs at the tip of the bottom layer. The cooling device is put in contact with the bottom of the mold. Several minutes after this, the mold is lowered into the cooling portion of the installation, where crystallization continues. Ideally, the rate at which the mold is lowered should equal the permissible rate of crystal growth. Photographs of single crystal turbine blades grown with axial orientation are presented.

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21

Steels

USSR

UDC 621.787.044:620.194.8

KARPENKO, G. V., PISTUN, I. P., KUSLITSKIY, A. B., TESLENKO, A. G., DURYAGIN, V. A., Physical-Mechanical Institute, Academy of Sciences UkrSSR and Ukrainian Polygraphic Institute, L'vov

ESSENTIAL DECREASE IN THE DANGEROUS EFFECT OF HYDROGEN ON STEEL HARDENED BY A SHOCK WAVE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 2, 1976 pp 392-394  
manuscript received 4 May 76

[Abstract] A study is made of type 20 steel hardened explosively. The mechanical properties, microhardness, residual stress, low-cycle durability and occlusion capacity for hydrogen were studied on sheet specimens 2.5 mm thick. The study showed that explosion treatment caused the strength and microhardness of the surface layer of the steel specimens to increase significantly and also resulted in significant compressive stresses. The factor apparently has a decisive effect, since a high level of residual compressive stresses impedes hydrogenation of the steel, particularly in the stressed state. Microfractographic study of fatigue rupture of specimens showed that low-cycle fatigue rupture occurs by separation of the material into layers along slitting planes. The form is that  
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USSR

KARPENKO, G. V., PISTUN, I. P., KUSLITSKIY, A. B., TESLENKO, A. G., DURYAGIN, V. A., DOKLADY AKADEMII NAUK SSSR Vol 230, No 2, 1976 pp 392-394

characteristic for serpentine shear. The two favorable factors of high residual compressive stress and significant evenplastic deformation of the surface layer predominate over the negative factor of increased brittleness, so that hydrogen is less dangerous for this steel than for ordinary steels.

2/2

USSR

UDC 669.018.2-156.6:620.183:620.17

KIDIN, I. N., ASTAF'YEVA, YE. V. and RYABOV, YE. S., Moscow Institute of Steel and Alloys

QUENCHING HIGH-SPEED STEEL USING RAPID HEATING

Moscow IZVESTIYA VUZ, CHERNAYA METALLURGIYA in Russian No 9, 1976  
pp 146-149 manuscript received 9 Dec 74

[Abstract] The processes of quenching after rapid heating at 50-2000 deg/sec of high-speed R6M5 and R18 steels from the temperature used during ordinary heat treatment of these steels and subsequent ordinary annealing do not permit obtaining a high degree of hardness and red hardness. The maximum possible increase in quenching temperature does not compensate the lack of time for conducting the diffusion processes of doping austenite during rapid heating. To obtain a high degree of hardness and red hardness it is necessary to hold it at the quenching temperature. Figures 2; tables 2; references 5: all Russian.

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USSR

UDC 669.14:669.788:620.178.3

MAKSIMCHUK, V. P. and PEROVA, T. A.

ANALYZING THE TENDENCY OF STEELS TO HYDROGEN CRACKING DURING TESTS FOR LONG-TERM STRENGTH

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 42, No 9, 1976 pp 1127-1129 manuscript received 5 May 75

[Abstract] The authors suggest a method for analyzing the tendency of steels to hydrogen cracking after contact with a hydrogenating medium. The method is based on the fact that the amount of the lower critical stress of hydrogenated steel (long-term strength limit) depends on the amount of hydrogen in it. They describe an attachment for testing flexible samples for long-term strength. The tests permit analyzing the maximal stresses at which this steel is efficient in the hydrogenated state. Figures 3; references 3: 2 Russian, 1 Western.

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USSR

UDC 669.14.018.8

UL'YANIN, YE. A., SOROKINA, N. A., GEORGIYEVA, I. YA., Central Scientific Research Institute for Ferrous Metallurgy

PROPERTIES OF STAINLESS CHROMIUM-MANGANESE STEELS WITH VARYING STABILITY OF AUSTENITE UPON DEFORMATION

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No. 9, 1976 pp 48-52

[Abstract] A study is made of the properties of chrome-manganese steel with varying content of manganese, which varies the resistance of the austenite to martensitic conversion upon plastic deformation. Manganese content varies from 14.1 to 22.1%, nickel content from 3.3 to 7.4%. It is concluded that stainless steels containing 14% Cr, 0.15% N and 14-22% Mn, austenitic when cooled to -253°C, undergo martensitic conversion forming the  $\alpha''$  and  $\epsilon''$  phases when deformed. The introduction of 3% Ni to a steel with 18% Mn suppresses martensitic conversion under these conditions. The mechanical properties of the steels in question are determined by the phase formation process during plastic deformation. The toughness and nature of rupture of the steels at low temperatures depend to a great extent on the stability of the austenite upon deformation.

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USSR

UL'YANIN, YE. A., SOROKINA, N. A., GEORGIYEVA, I. YA., METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV No. 9, 1976 pp 48-52

As the stability of the austenite increases, fracture shifts from brittle to mixed. The introduction of 3-5% Ni to a steel containing 18% Mn greatly increases the ductility and toughness at low temperatures.

2/2

USSR

UDC 620.178.162:621.785.539:661.65

BEZRUCHKO, V. P., KOROTYA, A. S., Zaporoshye Machine Building Institute  
Dneprovskiy Electrode Plant

RELATIVE WEAR RESISTANCE OF BORIDED STEELS TYPES 45, 20Kh, 30KhGSNA,  
Kh12F1

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian  
No. 9, 1976 pp 70-71

[Abstract] A study was made of the influence of boriding on the wear resistance of various steels in friction in a charge of anthracite, used as the primary component in pressing of carbon electrodes for electric-arc steel making furnaces. Boriding in a reaction mixture consisting of 95% BC<sub>4</sub>+2.5% Al<sub>2</sub>O<sub>3</sub>+2.5% NH<sub>4</sub>Cl was performed in a shaft furnace at 950°C for 5 hr. Wear resistance testing was performed on a type MI machine with a load of 75 kg/cm<sup>2</sup>. Of the steels studied, the most wear resistant in friction with anthracite was type 45 after boriding with subsequent hardening from 850°C in oil and tempering at 180°C, 2 hr.

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Thermomechanical Treatment

USSR

UDC 669.715:669-157.9

SHTEYNBERG, M. M., KAREVA, N. T., SMIRNOV, M. A., MOROZOV, O. P.,  
KORYAGIN, YU. D., and BURKANOV, K. K., Chelyabinsk

THE INFLUENCE OF THERMOMECHANICAL TREATMENT ON THE PROPERTIES OF  
ALUMINUM ALLOYS

Moscow IAN SSSR, METALLY in Russian No 5, 1976 pp 175-182 manuscript  
received 3 Sep 75

[Abstract] A study was made of the influence of low-temperature (LTTMT) and high-temperature thermomechanical treatment (HTTMT) on the structure and properties of two medium-strength alloys (AK6 and D1) and the V-95 high-strength alloy. It was found that low-temperature thermomechanical treatment has the greatest strengthening effect on the D1 and AK6 medium-strength aluminum alloys and the least effect on the V95 high-strength alloy; the greatest strengthening effect of LTTMT is achieved during deformation at 100-150°C. HTTMT also augments the strength properties of medium-strength aluminum alloys, and decreases the tendency toward brittle fracture. Low-temperature deformation (particularly between 100 and 150°C) and, to a considerably smaller extent, high-temperature deformation, intensify decomposition of the solid solution during subsequent aging. Plastic  
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USSR

SHTEYNBERG, M. M., KAREVA, N. T., SMIRNOV, M. A., MOROZOV, O. P.,  
KORYAGIN, YU. D., and BURKANOV, K. K., IAN SSSR, METALLY No 5, 1976  
pp 175-182

deformation during artificial aging (AK6 alloy) and during natural aging (D1 alloy) facilitates the transition from the zonal stage of decomposition to the later ones and may alter the quantity, dispersity, and distribution of the strengthening-phase particles. During thermomechanical treatment, the corrosion resistance of an alloy varies in relation to the nature of the structural changes introduced by plastic deformation. Figures 6; references 10: 9 Russian and 1 Western.

Thin Films

USSR

UDC 548.522:539.238

YEZHOVSKIY, YU. K., KALINKIN, I. P., Leningrad Technological Institute

PRODUCTION AND PROPERTIES OF THREE-COMPONENT EPITAXIAL THIN-FILM  
STRUCTURES BASED ON COMPOUNDS  $A_{II}B_{VI}$

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
No. 9, 1976 pp 1537-1540 manuscript received 29 Nov 74

[Abstract] Results are presented from the production of films of solid solutions in a quasiclosed volume by a three-temperature method, that is by coevaporation of compounds with substituent elements. The advantages of the method include more controllable changes in composition of the gas phase over the substrate and the possibility of using a broad range of melting points (over  $400^{\circ}\text{C}$ ). Two systems were selected based on cadmium sulfide:  $\text{CdS}_x\text{Te}_{1-x}$  and  $\text{Cd}_{1-x}\text{Zn}_x\text{S}$ . The growth rate of films, resistivity and width of the forbidden zone (composition) were studied as functions of pressure of the coevaporated element. It is shown that the method suggested can be used to produce both alloyed epitaxial layers and films of solid solutions.

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USSR

UDC 539.213:669.783.1.24.25

DRYAVTSEV, YU. V., LEVIN, YE. S., GEL'D, P. V., LEZHNEV, I. V.,  
Institute of Metal Physics, Acad. Sci. UkrSSR, Ural Polytechnic Institute

THE INFLUENCE OF TEMPERATURE ON THE RESISTIVITY AND MICROSTRUCTURE OF  
AMORPHOUS FILMS OF  $\text{Ni}_5\text{Ge}_3$ ,  $\text{Co}_5\text{Ge}_3$  AND  $\text{Fe}_5\text{Ge}_3$

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIYE MATERIALY in Russian  
No. 9, 1976 pp 1517-1521 manuscript received 23 Jan 75

[Abstract] Films of  $\text{Ni}_5\text{Ge}_3$ ,  $\text{Co}_5\text{Ge}_3$ ,  $\text{Fe}_5\text{Ge}_3$  were precipitated by the "flash" method in a special installation under a vacuum of  $5 \cdot 10^{-5}$  mmHg at 80 A/s. For the electron microscope studies, the substrates used were freshly fractured NaCl crystals, for resistivity measurements -- pyrex glass. Film thicknesses were determined by preliminary calculation and tested on an MII-4 microinterferometer, and varied from 200 to 500 Å. The study of the temperature dependences of resistivity and the electronographic and electron microscope studies showed that at room temperature, the films are in the amorphous state. Annealing of the films at  $250\text{--}350^{\circ}\text{C}$  for 1 hr results in crystallization. The temperature dependence of resistivity indicates the conditions of their conversion from the amorphous to the crystalline state. The changes in resistivity agree with the results of the study of massive specimens.

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USSR

UDC 539.216.2

KARPINOS, D. M., LISTOVICHNAYA, S. P., AYVAZOV, V. YA., MEDVEDEV, V. S.,  
and DOMASHCHENKO, L. N., Kiev

A STUDY OF THE PROPERTIES OF BORON NITRIDE FILMS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Sep-Oct 76  
pp 65-68 manuscript received 7 Oct 74

[Abstract] The investigation used a UVN-71R-2 vacuum apparatus with internal diodes having parallel plane electrodes. The target and the working chamber were carefully heated for degasification and the target was cleaned to eliminate oxidation. The specimens tested were annealed in a vacuum of  $3-5 \cdot 10^{-5}$  mm Hg at temperatures of 600-1500°C for one hour. This caused some thinning of the film, as revealed in infrared spectrum analysis, which also showed absorption bands characteristic for graphic-like modifications of boron nitride. Measurements of features of chips of the film also showed a graphite-type film modification. Results indicated that coatings of hexagonal boron nitride in a nitrogen plasma of high frequency application produce amorphous films similar in properties to the bulk material. High-temperature annealing reduced the compatibility  
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USSR

KARPINOS, D. M., LISTOVICHNAYA, S. P., AYVAZOV, V. YA., MEDVEDEV, V. S.,  
and DOMASHCHENKO, L. N., FIZIKA I KHIMIYA OBRABOTKI MATERIALOV No 5,  
Sep-Oct 76 pp 65-68

of several of the metals tested at varying temperatures between 1100 and 1400°C. The final products of contact reactions were apparently borides of the respective metals. Figures 2; references 8: 6 Russian and 2 English.

2/2

Titanium

USSR

UDC 669.17:621.785.16

BODYAKO, M. N., GORDIYENKO, A. I., SHIPKO, A. A. and TIMONIN, G. D.,  
Physico-Technical Institute, Belorussian SSR Academy of Sciences

INFLUENCE OF THE RATE OF HEATING AND SUBSEQUENT COOLING ON THE  
STRUCTURE, PHASE COMPOSITION AND MECHANICAL PROPERTIES OF THE VT30  
ALLOY

Minsk IZVESTIYA AN BSSR, SERIYA FIZIKO-TEKHNICHESKIKH NAUK in Rus-  
sian, No 3, 1976 pp 32-36 manuscript received 5 Nov 75

[Abstract] The authors investigate the mechanical properties, structure and phase composition of rods of a titanium alloy which has undergone heat treatment using an electric heater. They demonstrate the feasibility of using rapid heating for the operation of quenching rods of the VT30 alloy intended for cold seating of reinforcing parts. Figures 4; references 5: 2 Russian, 3 Western.

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USSR

UDC 621.762:669.018.29(088.8)

KRUPIN, A. V., SOLOV'YEV, V. YA., BEKSHIN, B. S. and IL'IN, N. S., Moscow  
Institute of Steel and Alloys

A METHOD OF MAKING SINTERED ARTICLES BASED ON TITANIUM

USSR AUTHOR'S CERTIFICATE No 483195, Division B, C, filed 1 Aug 73,  
published 31 Dec 75

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 8, 1976 Abstract No 8G562P]

[Text] A method is proposed for making sintered items based on titanium that involves hydrostatic pressing of the initial material and sintering in vacuum. Hydraulic extrusion is done at a specific pressure of 14-20 metric tons per square centimeter to simplify the process of making articles from titanium sponge and to increase density.

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USSR

UDC 621.762:669.018.29

ANTSIFEROV, V. N., ALEKSANDROVA, YE. P., BERESTOV, B. A., VAKUTIN, A. P., LOBANOVA, L. F., KHUDEN'KIKH, N. N. and SHUBIN, V. N.

DEVELOPMENT AND EXAMINATION OF TITANIUM-BASE SINTERED ALLOYS

Kiev SPECHENNYYE KONSTRUKTSIONNNYE MATERIALY [Sintered Construction Materials, Collection of Works] in Russian, 1976 pp 118-128

[From REFERATIVNYY ZHURNAL, METALLURGIYA, No 8, 1976 Abstract No 8G563 by T. Kozlovskaya]

[Text] An investigation is made of the kind of effect that dispersed oxides introduced into titanium have on the state and properties of the metallic base and the mechanical properties of the material as a whole. The addition of dispersed oxides to titanium appreciably alters the state of the metal matrix, depending on the type of oxide, the amount and the sintering conditions. The addition of dispersed oxides considerably increases the short-term and long-term strength of titanium, with a simultaneous reduction in ductility and resistance to brittle fracture at low temperatures. The resistance to brittle fracture of titanium and the strength of individual alloys are appreciably improved by heat treatment. A number of titanium

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USSR

ANTSIFEROV, V. N., ALEKSANDROVA, YE. P., BERESTOV, B. A., VAKUTIN, A. P., LOBANOVA, L. F., KHUDEN'KIKH, N. N. and SHUBIN, V. N., SPECHENNYYE KONSTRUKTSIONNNYE MATERIALY, 1976 pp 118-128

alloys have been developed with satisfactory properties in the sintered state at room temperature and high-temperature strength up to 550°C. The alloys are highly suited to machining and pressure working. Some of the alloys have been used to make aircraft engine parts. The economic effectiveness per unit is 3500 rubles. Figures 5, references 6.

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USSR

UDC 621.762:669.018.29(088.8)

ANTSIFEROV, V. N., LOBANOVA, L. F., KHUDEN'KIKH, N. N. and SHUBIN, V. N.,  
Perm' Polytechnical Institute

A SINTERED TITANIUM-BASE ALLOY

USSR AUTHOR'S CERTIFICATE No 467132, Division C, filed 26 Nov 73, published  
20 Oct 75

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 8, 1976 Abstract No 8G580P by  
T. Kozlovskaya]

[Text] A sintered titanium-base alloy is proposed that contains Al, Zr, Sn and Mo. To improve long-term strength, V and  $Al_2O_3$  are added with the following ratio of components (in %): Al -- 2-4, Zr -- 2-6, Sn -- 1-2.5, Mo -- 0.5-1, V -- 0.5-1,  $Al_2O_3$  -- 0.1-1 and the remainder Ti. The invention applies to the field of powder metallurgy, and specifically to sintered titanium-base alloys that can be used for making structural parts for operation over a wide temperature range under conditions of protracted applied stresses. Table 1.

1/1

USSR

UDC 669.295.5'71'28'292'26'1'85/86.018.2(088.8)

KHOREV, A. I. and MUKHINA, L. G.

A TITANIUM-BASE ALLOY

USSR AUTHOR'S CERTIFICATE No 483451, Division C, filed 11 Feb 74, published  
23 Dec 75

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 8, 1976 Abstract No 8I782P by  
V. Olenicheva]

[Text] A titanium alloy for aircraft and space vehicle equipment is proposed that is distinguished from known alloys in the added content of at least one rare earth metal. The new alloy contains (in %): Al 3-7, Mo 1-3, V 3-6, Cr 0.6-1.5, Fe 0.3-1, rare earth metal 0.01-0.8 and the remainder titanium. This ratio of components improves mechanical properties and reduces sensitivity to overheating. In the heat-hardened state the titanium alloy with equiaxial fine-grained structure has an ultimate strength of 165-180 kg/mm<sup>2</sup>, relative longitudinal extension of 6-12%, and relative lateral contraction of 15.45%; with overheated coarse structure -- ultimate strength 135-145 kg/mm<sup>2</sup>, relative longitudinal extension 4-7%, relative lateral contraction 8-16%.

1/1

USSR

UDC 621.771.001

KHMELININ, YU. F., ADAMESKU, R. A., SHISHMAKOV, A. S., and GEL'D, P. V.,  
Sverdlovsk

THE FORMATION OF ROLLING TEXTURE IN A BETA ALLOY OF TITANIUM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Sep-Oct 76  
pp 96-99 manuscript received 29 May 75

[Abstract] The alloy tested was rolled into bands of 5 mm thickness, then annealed for one hour at 850°C and cooled. Then part of the material was treated in a cyclical process at 800 ~~to~~ 700° to obtain a second initial type of metal. Cold rolling followed to obtain bands that has been compressed from 10 to 90 percent. The results, presented in diagrams and a table, indicated that deformation occurs primarily by creep in specific planes. Lateral creep was less pronounced and offers indirect confirmation of the low energy of defect compression the plane [211]. Cyclic annealing caused weakening of the basic textural components. One figure; references 12: 8 Russian and 4 Western.

1/1

USSR

UDC 620.178.7:669.295

MAL'KOV, A. V., KOLACHEV, V. A., Moscow Aviation Technology Institute

INFLUENCE OF HYDROGEN ON TITANIUM ALLOY RUPTURE ENERGY

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 2, Aug 76  
pp 364-371 manuscript received 3 Nov 75

[Abstract] A number of modern methods are tested for determination of the energy of rupture of metals as applicable to the problem of hydrogen embrittlement of titanium alloys. According to the hypothesis suggested the energy of rupture of titanium alloys depends directly on the type of stress state in microvolumes of the metal with increased stress concentration, while the nature of the stress state is determined by submicrostructural changes related to the redistribution of hydrogen atoms in the process of microcreep. As the content of hydrogen increases, the stress state in block flow bands changes so that the local yield point becomes practically equal to the theoretical strength, which in the large scale results in brittle rupture of the metal. This means that the dependence of a number of physical characteristics on hydrogen content of titanium alloys follows a basic S-shaped curve.

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USSR

UDC 669.295:620.251.1:620.181.1

D'YAKOVA, M. A., L'VOVA, YE. A., POTEKINA, T. G., KAGANOVICH, I. N.,  
ZVEREVA, Z. F., MESHCHANINOVA, L. S., Ural Polytechnical Institute

INFLUENCE OF TEMPERATURE OF HARDENING AND TEMPERING ON PHASE CONVERSIONS  
AND PROPERTIES OF THE TITANIUM ALLOYS VT3-1 AND VT9

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 2, Aug 76  
pp 333-339 manuscript received 20 Nov 75

[Abstract] This work presents a study of the influence of the temperature to which an alloy is heated for hardening in the range from 860 to 1000°C and for tempering in the range of 300 to 650°C on the phase composition of VT3-1 and VT9 titanium alloys. The phase composition of alloys was determined by the X-ray structural method on a DRON-1.5 machine using filtered copper radiation. The influence of hardening modes on strength properties such as hardness,  $\sigma_b$ ,  $\sigma_{0.2}$ ,  $\psi$ ,  $\Delta$  and  $E$  was also studied. The compositions of the alloys are: VT3-1: Al, 6.40; Mo, 2.70; Cr, 1.60; Si, 0.27; Fe, 0.37; N, 0.01; VT9: Al, 6.84; Mo, 3.39; Zr, 2.10; Si, 0.29; Fe, 0.16; C, 0.02; N, 0.03. These alloys show a significant increase in yield point, hardness, modulus of elasticity after hardening from 900-920°C,

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USSR

D'YAKOVA, M. A., L'VOVA, YE. A., POTEKINA, T. G., KAGANOVICH, I. N.,  
ZVEREVA, Z. F., MEXHCHANINOVA, L. S., FIZIKA METALLOV I METALLOVEDENIYE  
Vol. 42 No. 2, Aug 76 pp 333-339

and great differences in the yield points and ultimate strength. This results from the appearance of  $\alpha''$  martensite in the structure of the alloys and the fixation of a certain quantity of metastable  $\beta$  phase upon hardening. As the temperature of heating for hardening is increased from 900 to 1000°C, the quantity of  $\alpha''$  martensite increases, the degree of its alloying decreases, resulting in an increase in strength and a decrease in ductility of the alloy. Low tempering causes formation of  $\alpha''$  martensite by intermediate conversion. High tempering causes development of the  $\alpha$  phase. Still higher tempering causes rapid diffusion and high rates of decomposition of the metastable  $\beta$  phase with the formation of an  $\alpha+\beta$  structure in the initial stages of tempering.

2/2

USSR

UDC 669.295'71:620.183

KORNILOV, I. I., NARTOVA, T. T., CHERNYSHOVA, S. P., and NAYDAN, V. M.,  
Moscow

THE STRUCTURE AND PROPERTIES OF ALLOYS OF THE Ti-Al SYSTEM, HARDENED FROM  
THE  $\beta$ -REGION

Moscow IAN SSSR, METALLY in Russian No 5, 1976 pp 189-192 manuscript  
received 25 Jun 74

[Abstract] The structure and properties of binary Ti-Al alloys subjected to hardening from  $\beta$ -region temperatures were investigated. By X-ray analysis and investigation of the microstructure and some properties of Ti-Al alloys, it was established that after hardening from the  $\beta$ -region in alloys with up to 12% aluminum by weight a disordered  $\alpha$ -phase exists, while above this concentration of aluminum an ordering process takes place in the alloys. Periods of the crystal lattice in an alloy with 15.75% Al by weight (25% atomic), which has the structure of a  $Ti_3Al$  compound, are somewhat excessive in comparison to annealed alloys. Figures 4; references 6: 2 Russian and 4 Western.

1/1

USSR

UDC 669.295.5'71'296

KALININ, G. P., YELUTIN, O. P., and DORONINA, YE. V.

THE ELECTRICAL PROPERTIES OF ALLOYS OF THE Ti-Al-Zr SYSTEM

Moscow IAN SSSR, METALLY in Russian No 5, 1976 pp 220-223 manuscript  
received 18 Mar 75

[Abstract] Results are presented of an investigation of the electro-resistivity ( $\rho_0$ ), the temperature coefficient of electrical resistance, and the thermoelectromotive force, with respect to copper, of alloys of the titanium corner of the Ti-Al-Zr system. The studied alloys contain up to 50% Al and up to 10% Zr, with a change of the aluminum content every 1-2%, and a change of the zirconium content every 2%. It is shown that the ordering of alloys of the  $\alpha_2$ -phase region of the Ti-Al system takes place not in accordance with some single type of ordering, such as  $A_3B$  or  $A_2B$ , but depends on the aluminum content in the alloy and is accomplished in accordance with type  $A_3B$  at an aluminum content of about 16%, and in accordance with type  $A_2B$  at an aluminum content of about 22%. Figures 2; references 9: 3 Russian and 6 Western.

1/1

Welding

USSR

UDC 621.791.1

KARAKOZOV, E. S., GRIGOR'EVSKIY, V. I., PESHKOV, V. V., ORLOVA, L. M., and RADIONOV, V. N., Moscow and Voronezh

COMPOUND FORMATION AFTER THE REMOVAL OF COMPRESSING FORCE DURING PRESSURE WELDING WITH PREHEATING OF THE OT4 ALLOY

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Sep-Oct 76  
pp 113-117 manuscript received 5 Apr 76

[Abstract] The investigation used cylindrical specimens 16 mm in diameter and 30 mm in length; the bond surface of one part was polished while the other was planed to a purity of class V 7. Welding was accomplished with prior contact at a temperature of 850°C, relative pressure of 0.2 kG/mm<sup>2</sup>, and period of 30 min. Additional tests were administered to verify results without pressure, using coarse-grained structural materials. The difference in contact formation between fine grains and coarse showed that none of the mechanism hypotheses had defined the increase in the area of physical contact. The results indicate that external force in pressure welding should be released after formation of the joint. The effectiveness of forming a weld without pressure can be increased by reducing microscopic irregularities. The alloy welded should be of a fine-grained structure. Figures 5; references 10: 8 Russian and 2 English.

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USSR

UDC 621.791.052.004.67:669.715

IBATULLIN, R. L., STEPANOV, G. A., DYUBAROV, G. A.

INFLUENCE OF REPEATED BACKING ON THE PROPERTIES OF WELDED JOINTS IN ALUMINUM ALLOY AMg5

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, 1976 pp 35-36

[Abstract] This work deals with the study of the properties of welded butt joints of AMg5 aluminum alloy 8 mm thick after single and quadruple backing at temperatures of 20 and -196°C. Double backing produced no noticeable drop in the strength or impact toughness, while the relative elongation and bending angle decreased by 10-20 and 25-30% at test temperatures of 20 and -196°C respectively. Triple and quadruple backing significantly reduced the mechanical characteristics of the welded joints, particularly at low temperatures. Repeated backing, particularly triple and quadruple, facilitated the formation of new defects in the seam metal consisting of unfused sections and oxide inclusions.

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USSR

UDC 621.791.011:669.721

IVANOV, V. YA., SHORSHOROV, M. KH., ZENKOVA, E. K., PODGORSKIY, B. N., SOSHKO, V. V.

WELDABILITY OF MAGNESIUM ALLOYS IN THE SYSTEM Mg-Nd-Zr

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, 1976 pp 24-26

[Abstract] Thermally hardened sheets 2.0-2.5 mm thick, manufactured of alloys with varying contents of alloying elements were studied. The tendency toward crack formation was determined using a cross-shaped specimen produced by manual argon-arc welding. Nd content varied from 2.72 to 3.89%, Zr from 0.32 to 0.46%. It was established that as the Nd content was increased from 2.72 to 3.89% in the base material and up to 4.5% in the welding wire, the tendency of the system toward formation of hot cracks during welding was decreased. It is recommended that a base material consisting of 2.7-3.0% Nd, 0.4-0.5% Zr, remainder Mg be used for argon-arc welding, with a wire containing 2.5-2.7% Nd and 0.4-0.5% Zr.

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USSR

UDC 621.791.052.01:669.017.3:669.3

GRIGOR'YEV, A. K., ALEKSANDROV, A. A., GUSEV, YE. D., Leningrad Polytechnical Institute imeni M. I. Kalinin

DISLOCATION OF THE STRUCTURE OF THE WELDING ZONE IN COPPER DURING PACKET ROLLING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, 1976 pp 8-9

[Abstract] Pressure welding of both homogeneous and dissimilar metals is a topochemical reaction, characterized by three stages: development of physical contact between the metals to be joined; chemical interaction between them (activation of surface atoms and translation of bonds through the interphase contact surface); and relaxation processes in the joint formed, for example due to recrystallization or the formation of interlayers by heterodiffusion or reactive diffusion. The second stage is obviously the most interesting and complex. This study indicates that as the temperature and relative compression change during joint plastic deformation of copper, both the nature of the division boundary and the distribution of dislocations in the welding zone change. The formation of a firm bond of homogeneous metals upon hot welding by rolling is accompanied by the development of accumulated dislocations at the division boundary and gradual disappearance of the boundary itself due to collective recrystallization.

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USSR

UDC 621.791.01:621.47

UGLOV, A. A., AKHMEDOV, A. R., SMOL'SKIY, G. V.

ENERGY CONDITIONS OF WELDING WITH SOLAR RADIATION

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, 1976 pp 1-2

[Abstract] A study was made of the energy conditions required for solar welding. The required power was calculated using the thermal balance equation for the volume of the welding bath with full melting of sheets of moderate thickness. Experiments were performed on welding of metals at the focal point of a 1.5 m diameter concentrator, showing that the welded specimens must be held in a rigid clamp, eliminating the possibility of warping during welding, which can carry them away from the focal plane. The welding speed is usually low, not over 1.5 mm/s. A linear logarithmic dependence is observed between the dimensionless shape criterion of the bath and the mode established for argon-arc welding. After determining the required power and assigning the shape of the bath, it is possible to determine the mean energy density in the focal spot and, consequently, to calculate the required dimensions and accuracy of the concentrator.

1/1

USSR

UDC 621.791.001

RYABTSEV, I. A., KRENDELEVA, A. I., FRUMIN, I. I., Ye. O. Paton Institute of Electric Welding, Acad. Sci. UkrSSR

WELDABILITY OF WEAR-RESISTANT St3-DI54 BIMETALLIC SHEET

Kiev AVTOMATICHESKAYA SVARKA in Russian No 9, 1976 pp 15-16 manuscript received 11 Aug 75

[Abstract] The weldability of DI54 steel was preliminarily studied using plates of steel 8 mm thick (2.3% C, 5.8% Cr, 3.5% Ti, 0.6% Cu), surfaced with individual passes of a GS-1 electrode with a rod of type 08Kh20N10G6 wire coated with calcium fluoride. Some of the plates were hardened from 1100°C before surfacing. The quality of the clad layer in the area around the seam was tested visually and metallographically. Cracks were not found, indicating that proper heat treatment can allow welding of St3-DI54 bimetallic strips with GS-1 electrodes.

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USSR

UDC 621.791.927.5

KRAVTSOV, T. G., KRAPIVA, V. M., Zhdanov Affiliate of the Odessa Institute of Maritime Fleet Engineers

LENGTH OF THE WELDING BATH WITH LONGITUDINAL PLACEMENT OF A STRIP ELECTRODE

Kiev AVTOMATICHESKAYA SVARKA in Russian No 9, 1976 pp 5-7 manuscript received 12 Feb 76

[Abstract] The task of the present work was to establish the relationship between the main parameters of the process defining the length of the welding bath for the case of surfacing of massive parts with a longitudinally placed narrow strip. It is experimentally established that with longitudinal placement of the electrode, the power of the heat source can be varied over rather broad limits, while retaining high surfacing quality. Therefore, the bath length with displacement of the electrode may become quite significant (150-200 mm), and with surfacing with a broad split electrode may be 5 or 6 times greater than the width of the strip.

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Miscellaneous

USSR

UDC 669.275'71'24'25'3'2'931.018.58(088.8)

VISHNYAKOV, L. R., KARPINOS, D. M., PERESYPKIN, A. N., REVENKO, V. P. and TUCHINSKIY, L. I., Institute of Problems in Material Science, Academy of Sciences UkrSSR

A MAGNETICALLY HARD MATERIAL

USSR AUTHOR'S CERTIFICATE No 486071, Division C, filed 24 Dec 75, published 12 Jan 76

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 8, 1976 Abstract No 8I826P by V. Bochkareva]

[Text] The patent introduces a magnetically hard material with the distinguishing feature that impact toughness and strength are improved by the addition of tungsten, with the following proportions of components (%): Al 3-12, Ni 5-18, Co 8-27, Cu 1.5-5, Nb 0.3-1.2, W 1-60 and the remainder iron. The tungsten is used in the form of fibers, grids or strips. The proposed material is made by powder metallurgy or casting. Permanent magnets made from the described material also have improved technological and operational characteristics.

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USSR

UDC 669.245.018.44:539.43:536.4

LOZITSKIY, L. P., VETROV, A. N., IVANENKO, A. A., MOLOCHKOV, M. A. and OSINTSEV, M. M.

DURABILITY OF SPECIMENS OF EI602 HIGH-TEMPERATURE ALLOY WITH HEAT CYCLING

Kiev VOPROSY POVYSHENIYA NADEZHNOSTI, DOLGOVESHCHNOSTI I VOSSTANOVLENIYA AVIATSIONNOY TEKHNIKI [Problems of Improving the Reliability, Durability and Reconditioning of Aircraft Equipment, Collection of Works] in Russian No 1, 1975 pp 65-71

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 8, 1976 Abstract No 8I814 by the authors]

[Text] The paper gives the results of an experimental study of the durability of specimens of high-temperature sheet material EI602 subjected to cyclically alternating temperatures. Statistical processing of the test results is based on two laws of distribution of random quantities: Weybull distribution and logarithmically normal distribution. Fairly good agreement is found between the experimental data and both distribution laws. Figures 4, references 3.

1/1

USSR

UDC 532.64:546.821'26+546.21'681'682

KONONENKO, V. I., SHVEYKIN, G. P., SUKHMAM, A. L., LOMOVTSOV, V. I.,  
MITROFANOV, B. V., Sverdlovsk Chemical Institute

CHEMICAL COMPATIBILITY OF TITANIUM CARBIDE WITH MELTS OF ALUMINUM,  
GALLIUM AND INDIUM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 76 pp 48-52 manuscript  
received 27 Jun 76

[Abstract] This work presents a study of the compatibility of melts of gallium, indium and aluminum with titanium carbide over a broad temperature range by the method of measurement of contact wetting angles of substrates of TiC by melts of these metals. The contact wetting angles were studied by the lying drop method. The specimen and substrate were heated together when a vacuum of at least  $10^{-5}$  mmHg was reached. X-ray phase analysis showed that the TiC specimens synthesized were single-phase, homogeneous specimens, with a cubic lattice with parameter  $A=4.326$  Å, density  $d=4.904$  g/cm<sup>3</sup>, resistivity  $\rho=25 \cdot 10^{-6}$  ohm·m and Hall constant  $R_H= -20 \cdot 10^{-4}$  cm<sup>3</sup>/coul. The studies performed indicate that titanium carbide is stable in aluminum up to 1323°K, in gallium and indium

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USSR

KONONENKO, V. I., SHVEYKIN, G. P., SUKHMAM, A. L., LOMOVTSOV, V. I.,  
MITROFANOV, B. V., POROSHKOVAYA METALLURGIYA No. 9, Sep 76 pp 48-52

up to 1120°K. Analysis of the transition from nonwetting to flow indicates the need to study the influence of small quantities of oxygen in the initial specimen on the process of interaction of melts of Al, Ga and In with substrates of titanium carbide.

2/2

USSR

UDC 539.893

GALKIN, A. A., Academician of the Academy of Sciences Ukr SSR; DATSKO, O. I., PILIPENKO, N. P., and BAR'YAKHTAR, F. G., Donetsk Physico-Technical Institute, Academy of Sciences Ukr SSR

DAMPING ULTRASONICS IN METALS UNDER HYDROSTATIC HIGH PRESSURE

Moscow DOKLADY AKADEMII NAUK SSSR Vol 230, No 1, Sep-Oct 76 pp 78-81  
manuscript received 24 Feb 76

[Abstract] A study was made of materials with both cubic and non-cubic structures, including Al, Fe, Bi and Zn. The aluminum, bismuth and zinc had 99.99% purity, while the iron contained .03% carbon. Specimens in cylindrical form were prepared and subjected to hydrostatic pressure in a steel container using various fluids in ensure hydrostatic conditions. An echo-impulse procedure was then used for measuring damping. Results indicated that there are anomalies in polycrystal metals with non-cubic structures, while in other forms of structure, a regular pattern emerged. Thus, the basic cause of anomalies in damping ultrasonics was the granular boundaries that produced elastic irregularities and caused microplastic deformations. Apparently the deformations occur along various sliding 1/2

USSR

GALKIN, A. A., DATSKO, O. I., PILIPENKO, N. P., and BAR'YAKHTAR, F. G., DOKLADY AKADEMII NAUK SSSR Vol 230, No 1, Sep-Oct 76 pp 78-81

surfaces in zinc; in bismuth new sliding surfaces appear under high pressure. The final manifestation is the formation of greater density and microplastic deformations, wherein damping increases. With removal of pressure a reversal of these processes takes place. Figures 3; references 9: 6 Russian and 3 English.

2/2

USSR

UDC 536.36 + 536.5.081.7

SIROTA, N. N., Academician, Academy of Sciences Belorussian SSR; and KOFMAN, N. A., Institute of Solid State Physics and Semiconductors, Academy of Sciences Belorussian SSR, Minsk

THE TEMPERATURE DEPENDENCE OF THERMODYNAMIC FUNCTIONS OF THE WURZITE MODIFICATION OF BORON NITRIDE IN THE RANGE OF 5-320° K

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 1, Sep-Oct 76  
pp 82-84 manuscript received 13 Apr 76

[Abstract] The materials tested were obtained from the Institute of Problems of Material Science of the Academy of Sciences, Ukrainian SSR, in the form of powder with 0.14% Fe, 0.19%  $B_2O_3$ , and general additives, 0.93%. The specimen for calorimeter investigation was prepared from pressed blocks bound with BF-2 glue and weighing 17.2954 g. Before testing, the specimen was heated at 120°C for 1.5 hours. The measurements then taken allowed 5% error at temperatures below 25°K, and 1-2% error at higher temperatures. The results indicate that the heat capacity dependence of boron nitride in graphite form is not in agreement with Debay's findings. The results described concerning graphite-like and 1/2

USSR

SIROTA, N. N., and KOFMAN, N. A., DOKLADY AKADEMII NAUK SSSR Vol 230, No 1, Sep-Oct 76 pp 82-84

cubic modifications of boron nitride make possible a comparison of properties that includes consideration of structural features. Figures 3; references 5: 2 Russian and 3 English.

2/2

USSR

UDC 669.85/86:538.22

TONKOV, YE. YU., APTEKAR', I. L., DEGTYAREVA, V. F., and KRASAVIN, YU. I., Institute of Solid State Physics, Academy of Sciences USSR, Chernogolovka, Moscow Oblast'

CONVERTING THE HIGH-PRESSURE METASTABLE PHASE OF Gd, Tb, Dy and Ho TO THE STABLE PHASE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 230, No 1, Sep-Oct 76  
pp 85-87 manuscript received 2 Mar 76

[Abstract] The total elements were polycrystal specimens with 99.8% purity in the form of cylinders 4 X 4 mm. They were subjected to approximately 80 Kbar pressure at room temperature. Phase analysis was performed with X-rays. The effects of magnetic field impulses and thermocyclic annealing were also measured for the four elements. Results indicate that the conversion from the rhombohedral phase to the stable phase of Gd and Gd-La alloys is affected by cooling in measurable magnetic fields, and not simply by cooling alone. This occurs under the influence of forced magnetic tensions in an antiferromagnetic state of the Sm type which appears when the magnetic field is applied. Mechanical deformation also 1/2

USSR

TONKOV, YE. YU., APTEKAR', I. L., DEGTYAREVA, V. F., and KRASAVIN, YU. I., DOKLADY AKADEMII NAUK SSSR Vol 230, No 1, Sep-Oct 76 pp 85-87

brought the conversion to the stable phase in Gd, Tb, Dy and Ho with the Sm structure. Application of heat ranging from 200° to 300°C had similar effects for Tb and Gd. Data indicate that both pressure and magnetic fields decrease in effectiveness for the phase conversion in the order Gd, Tb, Dy, and Ho. References 7: 2 Russian and 5 English.

2/2

USSR

UDC 669.15'24'295:536.42

LYSAK, L. I., KONDRAT'YEV, S. P., TATARCHUK, V. S., Institute of Metal Physics, Acad. Sci. UkrSSR

INFLUENCE OF TEMPERING OF AUSTENITIC SINGLE CRYSTAL OF Fe-Ni-Ti ALLOY  
ON CRYSTALLINE STRUCTURE OF  $\alpha$ -MARTENSITE

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 2, Aug 76  
pp 344-349 manuscript received 8 Jan 76

[Abstract] An X-ray method is used to study an alloy based on iron with 31.2% Ni and 5.3% Ti (type N31T5). After tempering of the austenite at 700°C for less than 1-1.5 hr, the martensite lattice of the alloy is tetragonal with a maximum c/b axis ratio. This ratio then decreases and the lattice becomes rhombic. With tempering, the c axis decreases, the b axis increases, the a axis grows very slowly. This change in the crystalline lattice of martensite results from distortion due to coherence with the lattice of  $\gamma'$  phase particles. Analysis of the diffraction picture leads to the conclusion that distortion of the a axis is a result of Poisson's compression, resulting from strong changes in the b and c axes with unchanged volume of an elementary martensite unit cell.

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USSR

UDC 546.683+546.22

KAZANDZHAN, B. I., SELIN, YU. I., Moscow Power Engineering Institute

THE HALL EFFECT IN MELTS OF THE SYSTEM Tl-S

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIY MATERIALY in Russian  
No. 9, 1976 pp 1668-1670 manuscript received 28 Nov 74

[Abstract] The area of compositions 33-40 at.% S, including the stoichiometric composition, near which the thermal emf undergoes sign inversion and a sharp change is observed in the isotherms of conductivity, is selected to study the Hall effect in Tl-S melts. The results produced indicate the possibility of control (by variation of composition) of the concentration of electrons and holes in melts of the system Tl-S and the creation of conductivities with either type of carrier dominant.

USSR

UDC 546.27.661

ARABEY, B. G., GLUKHOV, V. A., MARKOV, YU. M., ROMANOVICH, I. V.,  
All-Union Scientific Research Institute for Aviation Materials

THE QUASIBINARY CROSS SECTION OF  $\text{EuB}_6\text{-CrB}_2$

Moscow IZVESTIYA AKADEMII NAUK SSSR, NEORGANICHESKIY MATERIALY in Russian  
No. 9, 1976 p. 1683 manuscript received 2 Sep 74

[Abstract] This study indicates that the  $\text{EuB}_6\text{-CrB}_2$  cross section is apparently a quasibinary cross section of eutectic type with variable solubility of the components in the solid state. The melting point of  $\text{EuB}_6$  is measured at  $2590^\circ\text{C}$ , of  $\text{CrB}_2$  --  $2170^\circ\text{C}$  ( $\pm 50^\circ\text{C}$ ). No significant evaporation of Eu from the  $\text{EuB}_6$  was observed. A graph of the quasi-binary cross section is presented.

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USSR

UDC 539.612:669.14.29:669.018.4

SAMSONOV, G. V., BONDAR', V. T., YEVUSHENKO, O. V., Institute of Problems of Material Science, Acad. Sci. UkrSSR

ADHESION INTERACTION OF A HARD ALLOY AND TYPE 45 STEEL

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 12, No 4, Jul-Aug 76 pp 105-106 manuscript received 12 Aug 75

[Abstract] This work presents a study of the adhesive interaction between the most common types of hard alloy, VK8 and T15K6 and type 45 steel both in the initial state and after application of coatings of titanium nitride to the hard alloy. Titanium nitriding at  $1200^\circ\text{C}$  for 2 hours allows an increase in the temperature of the beginning of seizing by  $150\text{--}180^\circ\text{C}$  and a retention of smoother contacting surfaces under these conditions. The temperature of the beginning of adhesion for the initial hard alloy was  $600^\circ\text{C}$  for VK8 and  $700^\circ\text{C}$  for T15K6.

1/1

USSR

UDC 669.27:620.186.5

GOLOVANENKO, S. A., NATAPOVA, A. B., KLYPIN, B. A., KESAYEV, T. M.,  
Central Scientific Research Institute for Ferrous Metallurgy

RECRYSTALLIZATION OF TUNGSTEN ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian  
No. 9, 1976 pp 59-60

[Abstract] Tungsten alloys are used as reinforcing fibers in heat resistant composite materials. The recrystallization temperature of unalloyed tungsten is greatly dependent on the content of impurities, varying from 1400°C for tungsten produced by powder metallurgy to 850°C for single crystal tungsten. The recrystallization temperature of tungsten alloys is less influenced by impurities. When tungsten is alloyed with refractory metals in significant quantities, the recrystallization temperature of tungsten first increases to a certain content of the alloying element, then decreases or remains constant. The highest recrystallization temperature is found in tungsten alloys containing dispersed oxide particles or carbide particles. This article studies the influence of the content of  $\text{ThO}_2$ , as well as combined alloying with

1/2

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GOLOVANENKO, S. A., NATAPOVA, A. B., KLYPIN, B. A., KESAYEV, T. M.,  
METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV No. 9, 1976 pp 59-60

molybdenum and rhenium and the introduction of dispersed particles of the carbides  $\text{HfC}$  and  $\text{NbC}$  on recrystallization of tungsten wire. Recrystallization of the wires was studied under comparatively short term (up to 1 hour) heating by transmission of current to 1600-2100°C and longer-term heating in a vacuum furnace at 1300-1500°C. Illustrations detected the influence of content of  $\text{ThO}_2$  on the temperature of the beginning of recrystallization and the dependence between time and recrystallization temperature for commercial tungsten alloys.

2/2

USSR

UDC 620.194

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KINETIC EFFECTS IN THE MECHANICS OF SLOW RUPTURE OF HIGH STRENGTH ALLOYS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 12, No 4, Jul-Aug 76 pp 9-24 manuscript received 16 Feb 76

[Abstract] This work is dedicated to the analysis of certain kinetic effects which have not yet been considered in the mechanics of slow rupture. The influence of loading history on the kinetics of subcritical crack growth in high strength steels under static and cyclical loading is studied. It is shown that in many cases the kinetic cracking diagrams of high strength alloys exposed to water and alcohol are not invariant characteristics of the materials, but rather depend on the loading history, particularly the initial values of the stress intensity factor. By decreasing the bond rupture energy at the tip of a crack, a medium facilitates subcritical crack growth; on the other hand, it facilitates processes of crack branching, thus effectively relaxing stresses and retarding subcritical crack growth. Such factors as loading history and

1/2

USSR

ROMANIV, O. N., NIKIFORCHIN, G. N., DEYEV, N. A., FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV Vol. 12 No. 4, Jul-Aug 76 pp 9-24

branching of cracks also have some influence on the nature of kinetic diagrams of alloy fatigue. A significant difference is discovered in the kinetics of fatigue cracks developing with monotonic increases in  $\Delta K$  from its initial values in areas I and II of the fatigue diagrams. Control of processes of crack branching must be looked upon as an important means of increasing the long-term crack resistance of alloys.

2/2

USSR

UDC 669.285

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INFLUENCE OF NITROGEN AND TITANIUM ON THE STRUCTURE AND PROPERTIES OF CAST MOLYBDENUM ALLOYS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 12, No 4, Jul-Aug 76 pp 109-111 manuscript received 4 Apr 74

[Abstract] This work presents a study of the phase composition of alloys in the molybdenum corner of the system Mo-Ti-N, studies the conditions of formation of their structure by the metallurgical method, as well as the influence of additional alloying of the matrix on their structure. The specimens were produced in an arc furnace with a nonconsumable tungsten electrode on a water-cooled copper bottom. In alloys of the system molybdenum-titanium-nitrogen (Russian code letters MTA) at the Mo-TiN cross section, the molybdenum-based solid solution is in equilibrium with the titanium nitride. This section of the Mo-Ti-N system is a quasibinary eutectic with a eutectic melting point of 2350°C. In

1/2

USSR

BARABASH, O. M., MOISEYEV, V. F., PECHKOVSKIY, E. P., TREFILOV, V. I., SHURIN, A. K., FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV Vol. 12 No. 4, Jul-Aug 76 pp 109-111

spite of the high content of titanium nitride, these alloys have good technological properties: the viscous-brittle transition temperature of cast MTA alloys is 250°C, and after equilibration annealing (1300-1500°C, 1 hour) -- approximately 125°C, the transition to brittle rupture occurring gradually due to the inhibition of brittle cracks by the hard particles. Alloying of MTA alloys with additional niobium can increase the content of nitrogen in the metal and decrease the required partial pressure of nitrogen in the melting volume, facilitating technological processes.

2/2

USSR

PALATNIK, L. S., TARTAKOVSKAYA, I. KH. and PUSAN, V. F., Khar'kov Polytechnic Institute imeni Lenin

ON A METHOD OF PRODUCING CONDENSED FILMS OF ALLOYS

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 42, No 9, 1976 pp 1106-1107

[Abstract] The authors suggest a method for producing condensed films of alloys that are similar in composition and uniform in thickness. They use the method of condensation in a vacuum on the surface of the substrate of different elements evaporated from individual evaporators. The method was tested using as an example the two-component eutectic system bismuth-lead. Figures 1.

1/1

USSR

UDC 669.184.2.042.39:546.21

KOMINOV, S. V., OKOROKOV, B. N., YAVOYSKIY, V. I., KREMYANSKIY, D. V., AKBIYEV, M. A. and BURDONOV, B. A., Moscow Institute of Steel and Alloys

ON THE EFFECTIVENESS OF INCREASING THE INTENSITY OF SCAVENGING IN THE OXYGEN-CONVERTER PROCESS

Moscow IZVESTIYA VUZ, CHERNAYA METALLURGIYA in Russian No 9, 1976 pp 46-50 manuscript received 20 May 75

[Abstract] The authors analyze the loss in time for individual operations in the melting cycle in highly loaded (270-ton) converters. They investigate the influence of the specific scavenging intensity on the mean rate of carbon oxidation and the oxygen utilization factor on the reaction of carbon oxidation. These indices are compared with similar ones for 55-ton and 130-ton units and with literature data. Figures 3; table 1; references 11: 9 Russian, 2 Western.

1/1

USSR

UDC 535.241.4

BARANOV, M. S., VERSHOK, B. A., and GEYNRIKHS, I. N., Moscow

EXPERIMENTAL TESTING OF MODELS OF CRATER FORMATION USING LASER BEAMS ON METAL

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Sep-Oct 76  
pp 3-8 manuscript received 13 Jan 76

[Abstract] Investigations were performed on the SLS-10-1 device with impulse periods of 2 and 4 msec, and beam wave length of 1.06 microns. The impulse was focused on the material surface and had an output energy of 10 joules, which was measured at intervals from 7-10 joules. Twelve technically pure metals were exposed to laser beams in this manner. Important parameters were the coefficients of absorption of optical radiation on the surface of the specimen and at the base of the crater being formed. Mathematical calculations were compared with actual experimental results, with a high degree of correlation. The calculated curve for crater formation in all cases was considerably lower than the experimental results. Other physical processes may be involved in the results because of the relatively high output energy of the laser beam. Further experimentation is indicated. Figures 6; references 11, all Russian.

1/1

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UDC 669.539.219.3

KRISHTAL, M. A., Tol'yatti

THE TECHNICAL DURABILITY OF ALLOYS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 5, Sep-Oct 76  
pp 69-77 manuscript received 16 Apr 76

[Abstract] The article reviews questions of technical durability related to the processing and use of metals and alloys under conditions where the diffusion component is essential, as in chemical and thermic processing, soldering and contacts with corrosive substances. Surface-active substances and corrosive environments, liquids, gases and solids, may be both adsorptive and corrosive. The various factors influencing metals and alloys, discussed in turn, are formation of dislocations in the zone of diffusion, adsorptive brittleness of solids in the area of contact with surface-active substances, the behavior of metal pores during diffusion and creep, the effects of soldering, welding, and surfacing, the effects of friction and failure during cutting, electrical deposits and the formation of joints, and corrosion failures. The factors considered show that in many cases not only the magnitude of durability properties but also structural features have a direct bearing on metal failure and the mechanical of failure. Careful and rational selection of technical properties is required for the metal or alloy needed. Formulas 4; references 12, all Russian.

1/1

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UDC 539,612:546.621'681'682'-54-143:821-549,21-206.1

KONONENKO, V. I., LOMOVSEV, V. I. and SUKHMAM, A. L., Sverdlovsk

THE ADHESION PROPERTIES OF MOLTEN Al, Ga, In ON SOLID TITANIUM AND GRAPHITE

Moscow IAN SSSR, METALLY in Russian No 5, 1976 pp 104-107 manuscript  
received 15 Apr 75

[Abstract] Results are presented of a study of the wetting of graphite and titanium substrates by molten Al, Ga, and In. Graphite was found to be stable with respect to molten Al, Ga, and In up to temperatures of 1303, 1073, and 973°K, respectively. Titanium begins to react with Al immediately after melting, and with Ga and In at 973 and 623°K respectively, which brings about rapid spreading of these metals along the substrate. Figures 2; references 9, all Russian.

1/1

USSR

UDC 669.71'782'884

DRITS, M. YE., KADANER, E. S., KUZ'MINA, V. I., and TURKINA, N. I. Moscow

THE PHASE COMPONENTS OF ALUMINUM-RICH Al-Si-Li ALLOYS

Moscow IAN SSSR, METALLY in Russian No 5, 1976 pp 206-208 manuscript  
received 24 Apr 75

[Abstract] Isothermal cross sections of the aluminum corner of the Al-Si-Li diagram of state at temperatures of 550, 500, and 200°C were constructed by the method of microstructural analysis. The separate and combined solubility of silicon and lithium in aluminum at temperatures of 550, 500, and 200°C were determined. The following phases were found to be in equilibrium with the aluminum solid solution: a Si-based solid solution, the LiAl compound, and phase T based on the ternary compound  $Li_3Al_2Si_2$ . Boundary determinations were made of the ternary aluminum-based solid solution  $\alpha$ , of the three biphasic regions  $\alpha + Si$ ,  $\alpha + T$  and  $\alpha + LiAl$ , and the two three-phase regions  $\alpha + Si + T$  and  $\alpha + T + LiAl$ . As the temperature decreased the single-phase region and the biphasic regions decreased considerably, and the three-phase regions expanded. A large region of homogeneity on the basis of the ternary compound was detected; as the temperature fell, this region decreased considerably. Figures 2; references: 4, all Russian.

1/1

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